

4 Data Quality Assurance, Management, and Usability

This section discusses the quality assurance (QA) and management process for the analytical data collected during the Supplemental RI. In addition to the discussion of the data QA process (which includes the analytical methodology, data validation, and data management), this section describes the content and usability of the data and the adequacy of the data in light of the Supplemental RI objectives.

4.1 Analytical Methods

Different analytical methods are used to analyze a particular sample, depending on the constituent for which the sample is being analyzed. Analytical methods used for sample analysis for the Supplemental RI data were performed in accordance with EPA's *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (SW-846) (EPA, 1997), EPA's *Methods for Chemical Analysis of Water and Wastes* (EPA, 1983), or Ecology's *MTCA Cleanup Regulation* (173-340 WAC) (Ecology, 2001), as appropriate. The specific analytical methods used were described in the investigation work plans and are listed in Table 4-1. The analyte list and reporting limits for sample analyses are presented in Table 4-2.

For the Supplemental RI, a sample analyte list was compiled based on previous investigations and historical information about the site. The actual analytes that were sampled for at each location depended on the results of the previous investigations and on the known and suspected former site activities that may have resulted in contamination with the analytes to be analyzed for at the sample location. Laboratory reports for the Supplemental RI data are included as Appendix E.

4.2 Data Validation

Data validation is the process of reviewing and accepting, qualifying, or rejecting data on the basis of established criteria. As explained below, none of the data are being rejected. Data validation criteria included the following:

- Target analytes and detection limits are appropriate;
- Dilution factors are identified;
- Samples are properly preserved;
- Analyses are completed within sample holding times;

- Laboratory blanks and field-associated blanks are within control limits;
- Laboratory control samples are within the established acceptance range;
- Sample spikes meet advisory limits;
- Duplicates, replicates, or spike duplicates meet advisory limits; and
- Organic target analyte qualitative criteria meet identification criteria.

Data may also be assessed for:

- Comparison of results to historical data and general credibility;
- Significant figures;
- Chain of custody;
- Data entry and transcription;
- Calculations;
- Identification of outliers, trends, and inconsistencies; and
- Comparison of the electronic data deliverables (EDDs) to the hardcopy reports.

The independent data validation process ensures technical quality and method compliance; provides precision, accuracy, and completeness assessments, which verify that adequate analytical documentation were performed and reported; and determines whether the analytical data are usable. Detailed discussions of the accuracy, precision, completeness, and method compliance are provided in the following sections.

All data validation followed the guidelines provided in EPA's *Contract Laboratory Program (CLP) National Functional Guidelines for Inorganic/Organic Data Review* (EPA, 1994, 1999), document numbers EPA540/R-99/008 and EPA540/R-94/013 of October 1999 (Inorganic) and February 1994 (Organic), as they applied to EPA SW-846 methodology. Field duplicate evaluation was based on validation criteria set forth by EPA Region I. The data collected during the Supplemental RI have been validated to CLP Level II. RETEC Level II data verification protocol is followed for site investigations that do not require full CLP or CLP-type data validation. With Level II data evaluation, the laboratory is entrusted to follow all internal quality control procedures (i.e., calibrations and performance checks) as

directed in the analytical methods reported. From the Level II data package generated, a definitive assessment of analytical precision, accuracy, and completeness can be made. Analytical documentation provided by the laboratory for a Level II data package can include: case narratives, detection limits, percent moisture calculations, dilution factors, method blanks, surrogates, matrix spikes, laboratory control samples, laboratory duplicates, extraction and analysis dates, and chain-of-custody forms.

Data validation reports for the Supplemental RI Report are included in Appendix F. In these reports, conclusions regarding data validation criteria (accuracy, precision, completeness, and method compliance as described below) are provided. The results of the validation, which indicate data usability, are presented in Section 4.4.

4.2.1 Accuracy

Field accuracy is a measure of sampling bias. It is determined by reviewing field, trip, and equipment rinse blank results for evidence of sample contamination stemming from field activities or sample transport.

Laboratory accuracy is a measure of the system bias. It is measured by evaluating laboratory control sample/laboratory control sample duplicate (LCS/LCSD), matrix spike/matrix spike duplicate (MS/MSD), and organic system monitoring compounds (surrogate) percent recoveries (%Rs). LCS/LCSD %Rs, which demonstrate the overall performance of the analysis, are compared to recommended or required EPA or laboratory control charted limits. MS/MSD %Rs, which provide information on sample matrix interferences, are compared to EPA published quality control limits or laboratory control charted limits. System monitoring compounds or surrogate recoveries, which measure system performance and efficiency during organic analysis, are compared to EPA published quality control limits or laboratory control charted limits where EPA published quality control limits were not available.

Data accuracy has been reviewed for each data package obtained from the analytical laboratory. A detailed description of the accuracy review and proportions of the data set both within and outside of the acceptable criteria range is discussed and included in each of the Data Validation Reports (Appendix F). The data validation performed for the Supplemental RI indicates that, although some of the data require qualification based on LCS, MS, or surrogate spike recoveries outside of the EPA published quality control limits or laboratory control charted limits, none of the data is rejected based on field or laboratory accuracy measurements and overall field and laboratory accuracy is acceptable.

4.2.2 Precision

Precision is the measure of variability of individual sample measurements. Field precision is determined by comparing field duplicate sample results. Laboratory precision is determined by examining laboratory duplicate results. Evaluation of both field and laboratory duplicates for precision is done using the relative percent difference (RPD) or percent difference (%D). The RPD is defined as the difference between two duplicate samples divided by the mean and expressed as a percent. The %D for serial dilutions during metals analysis indicates how close a diluted value corresponds with the original result. Laboratory RPD and %D limits reference EPA published quality control limits.

Data precision has been reviewed for each data package obtained from the analytical laboratory. A detailed description of the precision review and proportions of the data set both within and outside of the acceptable criteria range is discussed and included in each of the Data Validation Reports (Appendix F). The data validation performed for the Supplemental RI indicates that, although some of the data require qualification based on field duplicate and laboratory duplicate precision, none of the data is rejected based on field or laboratory precision measurements and overall the field and laboratory precision are acceptable.

4.2.3 Completeness

Completeness is the overall ratio of the number of samples planned versus the number of samples with valid analyses. Determination of completeness includes a review of chain-of-custody records, laboratory analytical methods and detection limits, laboratory case narratives, and project requirements. Completeness also includes 100 percent review of the laboratory sample data results, quality control summary reports, and EDDs.

Data completeness is reviewed for each data package obtained from the analytical laboratory. A detailed description of the completeness review and proportions of the data set is discussed and included in each of the Data Validation Reports (Appendix F). All of the data received by the laboratory are usable with qualification. Completeness of the data is calculated to be 100 percent and is acceptable.

4.2.4 Method Compliance

Method compliance is determined by evaluating sample integrity, holding times, laboratory blanks, system performance checks, initial and continuing instrument calibrations, internal standards, and target analyte identification and quantitation against method-specified requirements, while applying EPA data validation guidelines. Samples that do not meet the method compliance requirements are qualified accordingly, depending on the reason for non-compliance.

Method compliance has been reviewed for each data package obtained from the analytical laboratory. A detailed description of the method compliance review and proportions of the data set is discussed and included in each of the Data Validation Reports (Appendix F). The data validated for the Supplemental RI shows that, although some of the data required qualification based on analytes reported outside the quantitation range of the instrument, missed holding times, poor mass spectral match, baseline interference, and diphenyl ether (DPE) interference (dioxin/furan analysis only); none of the data is rejected based on method compliance measurements and overall method compliance is acceptable.

4.3 Data Management

This section discusses the data management process used to prepare this Supplemental RI Report. EQuIS[®] Chemistry and EQuIS[®] Geology database modules from EarthSoft were selected as the data management system for this project. EQuIS[®] was used to store field, laboratory, and data validation data. The EQuIS[®] central database platform is Microsoft[®] Access. The data warehouse provides a robust database format with tools to facilitate reporting as well as data export to many industry standard tools, such as Microsoft[®] Word, Microsoft[®] Excel, LogPlot[™], RockWorks[™], AutoCAD[®], ArcView[®], and Surfer[®].

The database administrator and select environmental personnel (including field geologists, engineers, and scientists) were the only personnel with writing permission to the database. This database was read only to all other data users to avoid errors.

EQuIS[®] includes an Import Module that provides the ability to import text files received from the laboratory as well as text files generated by RETEC staff for data unavailable from the laboratory (e.g., field notes and geologic data). In EQuIS[®] terminology, any text file to be imported into the database is termed an EDD. The EQuIS[®] Import Module also provides checks to ensure the integrity of data that is entered into the database. As an added measure of security, the EQuIS[®] Chemistry database uses a temporary and a permanent database. Data are initially entered into the temporary database where they can be reviewed and edited as needed prior to being merged into the permanent database. The permanent database is used as the source for all reporting and analysis.

The EQuIS[®] Reporting Module (CrossTab Report Writer) and custom queries were used to export geologic, hydrologic, and analytical chemistry data to various analysis and presentation tools.

4.3.1 Survey Data

All sample locations from the Supplemental RI were surveyed by professional surveyors or recorded in the field using a Trimble Pro XR GPS unit. The northing and easting coordinates of sample locations obtained using GPS were recorded in field notes for each location.

The coordinates recorded by the professional surveyors were delivered electronically in a Microsoft® Word format. The remaining sample coordinate data was downloaded from the GPS unit into a Microsoft® Excel file. The Microsoft® Excel file was modified to be consistent with requirements of the appropriate EQuIS® EDD format (e.g., fields were added and location nomenclature revised). The coordinate EDD file was imported into the EQuIS® database using the EQuIS® Import Module. A sample location map was then created and reviewed for accuracy and completeness of survey data.

4.3.2 Geologic/Hydrologic Data

Boring log field notes, which included both geology and lithology, were taken in the field for each drilling location. The notes were entered into an EQuIS® standardized EDD. The EDD was then imported into EQuIS®, using the EQuIS® Import Module. In the next step, the data was exported from EQuIS® to create LogPlot™ *.dat files, one file for each well. In LogPlot™, the field geologist added field notes data that is not included in the EQuIS® Geology database. A boring log was created for each LogPlot™ file and checked against the original field notes. Any edits needed were added to the LogPlot™ file and a new log was sent to the senior geologist. After the senior geologist reviewed the log, edits were incorporated.

4.3.3 Analytical Chemical Data

The analytical chemical data stored in EQuIS® includes field sample data, laboratory analyses and supporting data, and data validation results.

A field geologist/scientist recorded sample information into field notes as samples were collected in the field. These data included the sample location, sample date and time, sample identification number, sample depth, and analytical methods to be performed by the laboratory. Coolers containing samples were sent to the contracted lab with a chain of custody which noted the transference of possession of the sample containers from field personnel to the contracted lab.

The contracted and subcontracted labs sent hardcopy analysis reports and EDDs via e-mail to RETEC. The EDD file format from the contracted lab was compatible with EQuIS®, while the EDD file formats for the subcontracted labs were converted into an EQuIS® format by RETEC personnel.

Results from Ecology's split samples were delivered to RETEC by Ecology in Microsoft® Excel spreadsheets. The completeness and accuracy of these spreadsheets was not verified by RETEC. Ecology's split samples were identified with an "EC" in the sample ID, and Ecology identified the locations and depths of their split samples so they could be compared to samples collected by RETEC. Ecology's data was imported into Microsoft® Access tables and converted to EQuIS® EDD formatted text files by RETEC personnel.

The correctly formatted EDDs were imported into the EQuIS® Chemistry temporary database, using the EQuIS® Import Module. Following import, field personnel added field notes to the EQuIS® Chemistry temporary database, including information about field duplicates, sample depths, and other notes recorded in the field but not made available to the laboratory. Once this step was complete, the data were merged into the permanent database.

The analytical data was then exported to Microsoft® Excel using the EQuIS® Quick Report Module and sent to the data validator. The data validator imported the Microsoft® Excel file into a Microsoft® Access database for convenience of performing data validation procedures. The data validator compared the hardcopy laboratory data reports to the electronic data file to check for accuracy and to the chain of custody to check for completeness. The electronic file was checked for sample identifications, sample matrix, sample collection date and time, sample depths, laboratory project reference, analytical method reference, analyte name, sample concentration, laboratory reporting limit, unit of measurement, analytical fraction code, dilution fraction, and wet/dry reporting status.

After the data were validated, qualifiers were added to the electronic data file in Microsoft® Access, and the electronic data file was returned to the database administrator. The database administrator updated EQuIS® with data validation results, using update features in EQuIS®, checking that each record sent to the validator had been marked as validated.

4.3.4 Fluid Level Data

During fluid level measuring events, the fluid level data (water level and product thickness) was recorded as field notes for each well measured. The fluid level field observations were entered into Microsoft® Excel spreadsheets.

4.4 Data Usability

This section provides a discussion of the usability of the data set including historical data that have been integrated into the database for the Supplemental RI. All of the data collected for the Supplemental RI Report are considered usable.

4.4.1 Criteria for Determining Data Usability

Sample data, physical parameter data, and some qualitative or semi-quantitative data obtained from current and historical sampling events are used to support the major objectives of the RI. Data are usable if they support the following objectives (discussed in Section 1.3):

- Assess impacts to the Skykomish River;
- Define extent of LNAPL plume;
- Investigate former Maloney Creek channel;
- Define rail yard contamination; and
- Define off-site contamination.

4.4.2 Usability of Data from Historical Investigations

The discussion in this section establishes the “rules” to be applied to data for each of the goals listed above. These rules have been applied during data analysis to identify data sets that can be combined based on the above criteria and data sets that can be used for each goal. This ensures that data are evaluated and used correctly.

Chemical data collected during site investigation should not be used indiscriminately, but must meet specific criteria in order to be applied accurately and consistently. Not all data can be used for performing the analyses necessary to achieve each goal listed above. In general, to perform quantitative analyses using data sets from different sampling events, which are combined and evaluated as a whole, data sets must meet the following criteria:

- Comparable analytical detection limits and methods; and
- Similar data validation levels.

When using validated data, the data qualification flags must be taken into account. These flags indicate, for example, if the analytical result (i.e., analyte concentration) is estimated (J), undetected (U), undetected at an estimated reporting limit (UJ), or rejected (R). Qualified data are listed in Table 4-1.

Data collected during the Supplemental RI work met the criteria for combining and evaluating data sets; therefore, the data sets have been grouped for evaluation of nature and extent of soil, sediment, and groundwater contamination.

Data sets for investigations completed prior to the Supplemental RI are described in Section 2 of the Supplemental RI Report.

All historical pre-Supplemental RI and Supplemental RI data have been validated to CLP Level II. All validated soil data was deemed usable and

have been presented in this Supplemental RI Report. Older groundwater data were presented in the Draft RI Report and neither these water analyses nor later pre-Supplemental RI groundwater data will be presented in the Supplemental RI Report to define the current nature and extent of contamination because groundwater chemistry changes with time (although laboratory reports and data validation reports for post-Draft RI/pre-Supplemental RI groundwater sampling events are included in Appendices E and F, respectively). Only the groundwater chemistry data collected during the Supplemental RI fieldwork is presented herein.

Table 4-1 Summary of Data Validation and Usability

Sample ID	Lab Project	Method	Parameter	Concentration	Unit	Reason Code
November 2001 through January 2002 Soil and Water Quality Control Samples						
1A-SS-2	DW54	SW6010B initial	Lead	141 J	mg/kg	RPD
1A-SS-4	DW54	SW6010B initial	Lead	130 J	mg/kg	RPD
1A-SS-5	DW54	SW6010B initial	Lead	156 J	mg/kg	RPD
1B-SS-3	DW54	SW6010B initial	Lead	21 J	mg/kg	RPD
1B-SS-6	DW54	SW6010B initial	Lead	75 J	mg/kg	RPD
1B-SS-8	DW54	SW6010B initial	Lead	148 J	mg/kg	RPD
1C-SS-2	DW54	SW6010B initial	Lead	56 J	mg/kg	RPD
1C-SS-4	DW54	SW6010B initial	Lead	143 J	mg/kg	RPD
5-SS-1	DW54	SW6010B initial	Lead	107 J	mg/kg	RPD
5-SS-10	DW54	SW6010B initial	Lead	144 J	mg/kg	RPD
5-SS-13	DW54	SW6010B initial	Lead	139 J	mg/kg	RPD
5-SS-14	DW54	SW6010B initial	Lead	41 J	mg/kg	RPD
5-SS-15	DW54	SW6010B initial	Lead	16 J	mg/kg	RPD
5-SS-16	DW54	SW6010B initial	Lead	229 J	mg/kg	RPD
5-SS-17	DW54	SW6010B initial	Lead	101 J	mg/kg	RPD
5-SS-2	DW54	SW6010B initial	Lead	40 J	mg/kg	RPD
5-SS-3	DW54	SW6010B initial	Lead	19 J	mg/kg	RPD
5-SS-4	DW54	SW6010B initial	Lead	6 J	mg/kg	RPD
5-SS-50	DW54	SW6010B initial	Lead	170 J	mg/kg	RPD
5-SS-6	DW54	SW6010B initial	Lead	191 J	mg/kg	RPD
5-SS-7	DW54	SW6010B initial	Lead	151 J	mg/kg	RPD
5-SS-9	DW54	SW6010B initial	Lead	502 J	mg/kg	RPD
1A-SS-1	DW55	SW6010B initial	Lead	716 J	mg/kg	RPD
1B-SS-5	DW55	SW6010B initial	Lead	420 J	mg/kg	RPD
1C-SS-1	DW55	SW6010B initial	Lead	144 J	mg/kg	RPD
1C-SS-10	DW55	SW6010B initial	Lead	49 J	mg/kg	RPD
1C-SS-11	DW55	SW6010B initial	Lead	71 J	mg/kg	RPD
1C-SS-14	DW55	SW6010B initial	Lead	64 J	mg/kg	RPD
1C-SS-5	DW55	SW6010B initial	Lead	29 J	mg/kg	RPD
1C-SS-50	DW55	SW6010B initial	Lead	53 J	mg/kg	RPD
1C-SS-6	DW55	SW6010B initial	Lead	174 J	mg/kg	RPD
1C-SS-7	DW55	SW6010B initial	Lead	72 J	mg/kg	RPD
1C-SS-8	DW55	SW6010B initial	Lead	52 J	mg/kg	RPD
2B-SS-5	DW55	SW6010B initial	Lead	86 J	mg/kg	RPD
3-SS-2	DW55	SW6010B initial	Lead	16 J	mg/kg	RPD
4-SS-3	DW55	SW6010B initial	Lead	170 J	mg/kg	RPD
4-SS-4	DW55	SW6010B initial	Lead	19 J	mg/kg	RPD
4-SS-7	DW55	SW6010B initial	Lead	243 J	mg/kg	RPD
4-SS-8	DW55	SW6010B initial	Lead	97 J	mg/kg	RPD
4-SS-9	DW55	SW6010B initial	Lead	108 J	mg/kg	RPD
5-SS-11	DW55	SW6010B initial	Lead	44 J	mg/kg	RPD
5-SS-5	DW55	SW6010B initial	Lead	64 J	mg/kg	RPD
5-SS-55	DW55	SW6010B initial	Lead	65 J	mg/kg	RPD
5-SS-8	DW55	SW6010B initial	Lead	19 J	mg/kg	RPD
1A-W-2	DX18	SW8270-SIM initial	Anthracene	100 J	µg/kg	LSM
		SW8270-SIM reanalysis	Benzo(a)pyrene	< 70 UJ	µg/kg	MI
			Benzo(b)fluoranthene	< 47 UJ	µg/kg	MI
			Benzo(k)fluoranthene	< 70 UJ	µg/kg	MI
		SW8270-SIM initial	Dibenzofuran	94 J	µg/kg	LSM
			Naphthalene	< 31 UJ	µg/kg	MI
1A-SS-103	DX19	SW7060A initial	Arsenic	6.8 J	mg/kg	MS
1A-SS-3	DX19	SW7060A initial	Arsenic	6.3 J	mg/kg	MS
1B-SS-4	DX19	SW7060A initial	Arsenic	2.4 J	mg/kg	MS
1B-SS-7	DX19	SW7060A initial	Arsenic	16.7 J	mg/kg	MS

Table 4-1 Summary of Data Validation and Usability

Sample ID	Lab Project	Method	Parameter	Concentration	Unit	Reason Code	
November 2001 through January 2002 Soil and Water Quality Control Samples (Continued)							
2A-B-5-0-2.5	DX19	NWTPHD initial	Diesel Range Hydrocarbons	2,300	J	mg/kg	MS, RPD
			Motor Oil Range Hydrocarbons	950	J	mg/kg	MS, RPD
2A-B-5-15:40	DX19	SW7060A initial	Arsenic	4.3	J	mg/kg	MS
2A-B-5-16:00	DX19	SW8270-SIM initial	Anthracene	300	J	µg/kg	LSM
2A-GS-50	DX19	SW7060A initial	Arsenic	12.1	J	mg/kg	MS
2B-SD-1-M1	DX19	SW7060A initial	Arsenic	13.9	J	mg/kg	MS
2B-SD-1-M2	DX19	SW7060A initial	Arsenic	8.3	J	mg/kg	MS
2B-SD-1-M3	DX19	SW7060A initial	Arsenic	1.9	J	mg/kg	MS
2B-SS-3	DX19	SW7060A initial	Arsenic	15.3	J	mg/kg	MS
4-SS-1	DX19	SW7060A initial	Arsenic	54	J	mg/kg	MS
2A-GS-55	DX75	SW6010B initial	Lead	125	J	mg/kg	FD
		SW7060A initial	Arsenic	3.7	J	mg/kg	FD
2A-GS-55-2	DX75	SW6010B initial	Lead	242	J	mg/kg	FD
		SW7060A initial	Arsenic	12.2	J	mg/kg	FD
2A-GS-38	DX76	SW6010B initial	Lead	108	J	mg/kg	RPD
2A-GS-40	DX76	SW6010B initial	Lead	52	J	mg/kg	RPD
2A-GS-52	DX76	SW6010B initial	Lead	60	J	mg/kg	RPD
2A-GS-53	DX76	SW6010B initial	Lead	30	J	mg/kg	RPD
2A-GS-54	DX76	SW6010B initial	Lead	11	J	mg/kg	RPD
2A-GS-56	DX76	SW6010B initial	Lead	179	J	mg/kg	RPD
2A-GS-57	DX76	SW6010B initial	Lead	113	J	mg/kg	RPD
2A-GS-59	DX76	SW6010B initial	Lead	123	J	mg/kg	RPD
2A-GS-60	DX76	SW6010B initial	Lead	184	J	mg/kg	RPD
2A-GS-70	DX76	SW6010B initial	Lead	17	J	mg/kg	RPD
2A-GS-72	DX76	SW6010B initial	Lead	10	J	mg/kg	RPD
2A-GS-73	DX76	SW6010B initial	Lead	648	J	mg/kg	RPD
2A-GS-74	DX76	SW6010B initial	Lead	117	J	mg/kg	RPD
2A-GS-75	DX76	SW6010B initial	Lead	34	J	mg/kg	RPD
2A-GS-76	DX76	SW6010B initial	Lead	60	J	mg/kg	RPD
2A-GS-77	DX76	SW6010B initial	Lead	58	J	mg/kg	RPD
2A-GS-78	DX76	SW6010B initial	Lead	224	J	mg/kg	RPD
2A-GS-79	DX76	SW6010B initial	Lead	407	J	mg/kg	RPD
2A-GS-80	DX76	SW6010B initial	Lead	172	J	mg/kg	RPD
2A-GS-82	DX76	SW6010B initial	Lead	136	J	mg/kg	RPD
2A-GS-83	DX76	SW6010B initial	Lead	287	J	mg/kg	RPD
2A-GS-84	DX76	SW6010B initial	Lead	257	J	mg/kg	RPD
2A-GS-85	DX76	SW6010B initial	Lead	122	J	mg/kg	RPD
2A-GS-86	DX76	SW6010B initial	Lead	45	J	mg/kg	RPD
2A-GS-87	DX76	SW6010B initial	Lead	218	J	mg/kg	RPD
2A-GS-88	DX76	SW6010B initial	Lead	40	J	mg/kg	RPD
2A-GS-91	DX76	SW6010B initial	Lead	47	J	mg/kg	RPD
2A-W-6-7.5-10	DX77	NWTPHD reextract	Motor Oil Range Hydrocarbons	410	J	mg/kg	HT
5-W-4-7.5-10	DX77	SW8270-SIM initial	Anthracene	76	J	µg/kg	LSM
			Benzo(b)fluoranthene	< 110	UJ	µg/kg	MI
			Benzo(k)fluoranthene	< 110	UJ	µg/kg	MI
			Phenanthrene	33	J	µg/kg	LSM
1C-W-2-20.5	DX78	NWTPHD initial	Diesel Range Hydrocarbons	< 5	UJ	mg/kg	SUR
			Motor Oil Range Hydrocarbons	< 10	UJ	mg/kg	SUR
2A-B-13-17	DX78	NWTPHD initial	Diesel Range Hydrocarbons	< 5	UJ	mg/kg	SUR
			Motor Oil Range Hydrocarbons	< 10	UJ	mg/kg	SUR
2A-B-13-2.5-5	DX78	NWTPHD initial	Diesel Range Hydrocarbons	< 5	UJ	mg/kg	SUR
			Motor Oil Range Hydrocarbons	< 10	UJ	mg/kg	SUR
2A-B-14-2.5-5	DX78	NWTPHD reextract	Diesel Range Hydrocarbons	16	J	mg/kg	HT
			Motor Oil Range Hydrocarbons	28	J	mg/kg	HT

Table 4-1 Summary of Data Validation and Usability

Sample ID	Lab Project	Method	Parameter	Concentration	Unit	Reason Code
November 2001 through January 2002 Soil and Water Quality Control Samples (Continued)						
2B-B-5-0-2	DX78	NWTPHD reextract	Diesel Range Hydrocarbons	200 J	mg/kg	HT
			Motor Oil Range Hydrocarbons	170 J	mg/kg	HT
2B-B-5-11	DX78	NWTPHD reextract	Diesel Range Hydrocarbons	16 J	mg/kg	HT
			Motor Oil Range Hydrocarbons	34 J	mg/kg	HT
2A-B-15-15	DX79	NWTPHD reextract	Diesel Range Hydrocarbons	60 J	mg/kg	HT
			Motor Oil Range Hydrocarbons	62 J	mg/kg	HT
5-W-3-8.5	DX79	NWTPHD initial	Diesel Range Hydrocarbons	12,000 J	mg/kg	FD
			Motor Oil Range Hydrocarbons	9,200 J	mg/kg	FD
5-W-3-85	DX79	AREPH reanalysis	C21-C34 Aromatics	3,300,000 J	µg/kg	SUR
		NWTPHD initial	Diesel Range Hydrocarbons	27,000 J	mg/kg	FD
			Motor Oil Range Hydrocarbons	21,000 J	mg/kg	FD
		SW8270-SIM initial	Anthracene	830 J	µg/kg	LSM
			Benzo(b)fluoranthene	< 710 UJ	µg/kg	MI
			Benzo(k)fluoranthene	< 950 UJ	µg/kg	MI
1B-W-1	DX90	AREPH initial	C12-C16 Aromatics	33,000 J	µg/kg	MS, RPD
			C16-C21 Aromatics	140,000 J	µg/kg	MS
			C21-C34 Aromatics	83,000 J	µg/kg	MS, PRD
1B-W-1-115	DX90	NWTPHD initial	Diesel Range Hydrocarbons	1,100 J	mg/kg	FD
			Motor Oil Range Hydrocarbons	200 J	mg/kg	FD
1B-W-1-15	DX90	NWTPHD initial	Diesel Range Hydrocarbons	1,400 J	mg/kg	SUR
			Motor Oil Range Hydrocarbons	220 J	mg/kg	SUR
1B-W-1-21	DX90	NWTPHD reanalysis	Diesel Range Hydrocarbons	< 5.0 UJ	mg/kg	SUR, FD
			Motor Oil Range Hydrocarbons	< 10 UJ	mg/kg	SUR, FD
2B-SD-5-2.5-5	DX90	SW8270-SIM initial	Anthracene	100 J	µg/kg	LSM
			Benzo(b)fluoranthene	< 160 UJ	µg/kg	MI
			Benzo(k)fluoranthene	< 230 UJ	µg/kg	MI
5-SD-1-0-2.5	DX90	NWTPHD reextract	Diesel Range Hydrocarbons	30 J	mg/kg	HT
			Motor Oil Range Hydrocarbons	42 J	mg/kg	HT
EB-1207-2	DX90	E415.1 initial	Total Organic Carbon	< 1.5 UJ	mg/L	HT
2B-B-4-2.5-5	DX95	NWTPHD reextract	Diesel Range Hydrocarbons	57 J	mg/kg	HT
			Motor Oil Range Hydrocarbons	140 J	mg/kg	HT
2B-B-4-5-6.5	DX95	NWTPHD reextract	Diesel Range Hydrocarbons	26 J	mg/kg	HT
			Motor Oil Range Hydrocarbons	72 J	mg/kg	HT
2B-SD-2-0-2.5	DX95	NWTPHD reextract	Diesel Range Hydrocarbons	64 J	mg/kg	HT
			Motor Oil Range Hydrocarbons	170 J	mg/kg	HT
2B-SD-4-2.5-5	DX95	SW8270-SIM initial	Benzo(b)fluoranthene	250 J	µg/kg	LSM
			Benzo(k)fluoranthene	410 J	µg/kg	LSM
4-B-1-0-2	DX95	NWTPHD initial	Diesel Range Hydrocarbons	9.7 J	mg/kg	SUR, RPD
			Motor Oil Range Hydrocarbons	36 J	mg/kg	SUR, RPD
5-W-1-0-6/12-18	DX95	NWTPHD reextract	Diesel Range Hydrocarbons	130 J	mg/kg	HT
			Motor Oil Range Hydrocarbons	590 J	mg/kg	HT
5-W-1-8	DX95	NWTPHD initial	Diesel Range Hydrocarbons	3,400 J	mg/kg	ELR, FD
5-W-1-80	DX95	NWTPHD initial	Diesel Range Hydrocarbons	2,400 J	mg/kg	FD
2A-B-7	DX98	SW8270-SIM initial	Benzo(b)fluoranthene	< 1,000 UJ	µg/kg	MI
			Benzo(k)fluoranthene	< 1,300 UJ	µg/kg	MI
2A-W-1-0-2	DX98	NWTPHD initial	Diesel Range Hydrocarbons	54 J	mg/kg	MS
			Motor Oil Range Hydrocarbons	95 J	mg/kg	MS
2A-W-10-12.5-15	DY09	NWTPHD initial	Diesel Range Hydrocarbons	< 5 UJ	mg/kg	SUR
			Motor Oil Range Hydrocarbons	13 J	mg/kg	SUR
2A-W-10-16	DY09	AREPH initial	C10-C12 Aromatics	< 4,500 UJ	µg/kg	LCS
2A-W-3-10	DY09	NWTPHD initial	Diesel Range Hydrocarbons	1,400 J	mg/kg	FD
2A-W-3-100	DY09	NWTPHD initial	Diesel Range Hydrocarbons	760 J	mg/kg	FD

Table 4-1 Summary of Data Validation and Usability

Sample ID	Lab Project	Method	Parameter	Concentration	Unit	Reason Code	
November 2001 through January 2002 Soil and Water Quality Control Samples (Continued)							
2A-W-3-17	DY09	AREPH initial	C10-C12 Aromatics	19,000	J	µg/kg	LCS
		SW8270-SIM initial	Acenaphthene	220	J	µg/kg	LSM
			Anthracene	220	J	µg/kg	LSM
			Benzo(a)anthracene	120	J	µg/kg	LSM
			Benzo(a)pyrene	< 180	UJ	µg/kg	MI
			Benzo(b)fluoranthene	< 72	UJ	µg/kg	MI
			Benzo(k)fluoranthene	< 61	UJ	µg/kg	MI
			Dibenzofuran	< 120	UJ	µg/kg	MI
			Fluoranthene	190	J	µg/kg	LSM
			Fluorene	1,100	J	µg/kg	LSM
			Naphthalene	< 89	UJ	µg/kg	MI
			Phenanthrene	260	J	µg/kg	LSM
2A-W-7-12	DY09	AREPH initial	C10-C12 Aromatics	< 3,500	UJ	µg/kg	LCS
2A-W-7-120	DY09	AREPH initial	C10-C12 Aromatics	< 3,500	UJ	µg/kg	LCS
5-W-2-8	DY10	AREPH initial	C10-C12 Aromatics	< 30,000	UJ	µg/kg	LCS
		SW8270-SIM initial	Anthracene	450	J	µg/kg	LSM
			Fluoranthene	450	J	µg/kg	LSM
5-W-2-80	DY10	AREPH initial	C10-C12 Aromatics	< 30,000	UJ	µg/kg	LCS
		SW8270-SIM initial	Anthracene	670	J	µg/kg	LSM
2A-B-110-9	DY12	ALEPH initial	C21-C34 Aliphatics	3,000	J	mg/kg	FD
		AREPH initial	C10-C12 Aromatics	< 11,000	UJ	µg/kg	LCS
			C12-C16 Aromatics	160,000	J	µg/kg	FD
		SW8270-SIM initial	2-Methylnaphthalene	6,400	J	µg/kg	FD
			Dibenzofuran	< 910	UJ	µg/kg	MI
			Fluoranthene	910	J	µg/kg	LSM
			Fluorene	4,800	J	µg/kg	LSM, FD
			Naphthalene	< 860	UJ	µg/kg	MI
2A-B-11-12.5-15	DY12	NWTPHD reextract	Diesel Range Hydrocarbons	5,500	J	mg/kg	HT
			Motor Oil Range Hydrocarbons	1,900	J	mg/kg	HT
2A-B-11-150-175	DY12	NWTPHD initial	Diesel Range Hydrocarbons	59	J	mg/kg	FD
			Motor Oil Range Hydrocarbons	35	J	mg/kg	FD
2A-B-11-15-17.5	DY12	NWTPHD initial	Diesel Range Hydrocarbons	140	J	mg/kg	FD
			Motor Oil Range Hydrocarbons	63	J	mg/kg	FD
2A-B-11-9	DY12	ALEPH initial	C21-C34 Aliphatics	1,700	J	mg/kg	FD
		AREPH initial	C10-C12 Aromatics	71,000	J	µg/kg	LCS
			C12-C16 Aromatics	620,000	J	µg/kg	FD
		SW8270-SIM initial	2-Methylnaphthalene	20,000	J	µg/kg	FD
			Acenaphthylene	< 910	UJ	µg/kg	MI
			Anthracene	1,500	J	µg/kg	LSM
			Dibenzofuran	< 1,700	UJ	µg/kg	MI
			Fluorene	8,100	J	µg/kg	LSM, FD
Naphthalene	< 1,100	UJ	µg/kg	MI			
2A-B-12-11	DY12	NWTPHD initial	Diesel Range Hydrocarbons	23,000	J	mg/kg	FD
2A-B-12-110	DY12	NWTPHD initial	Diesel Range Hydrocarbons	13,000	J	mg/kg	FD
2A-B-12-17	DY12	NWTPHD initial	Diesel Range Hydrocarbons	< 5	UJ	mg/kg	MS
3-B-2-12	DY21	AREPH initial	C10-C12 Aromatics	< 4,300	UJ	µg/kg	LCS
4-GS-1025	DY21	SW7060A initial	Arsenic	110	J	mg/kg	FD
4-GS-25	DY21	SW7060A initial	Arsenic	19	J	mg/kg	FD
2A-B-19-0-2	DY84	SW7060A initial	Arsenic	16	J	mg/kg	RPD, MS
5-B-5-0-6	DY84	SW7060A initial	Arsenic	6.6	J	mg/kg	RPD, MS
5-B-5-12-18	DY84	SW7060A initial	Arsenic	11.9	J	mg/kg	RPD, MS
5-B-6-0-2	DY84	SW7060A initial	Arsenic	13	J	mg/kg	RPD, MS
1C-W-1-13	DY87	SW8270-SIM initial	Anthracene	< 120	UJ	µg/kg	MI
			Phenanthrene	45	J	µg/kg	LSM

Table 4-1 Summary of Data Validation and Usability

Sample ID	Lab Project	Method	Parameter	Concentration	Unit	Reason Code
November 2001 through January 2002 Soil and Water Quality Control Samples (Continued)						
2A-B-1-0-6	DY93	8290 initial	2,3,7,8-TCDD	0.33 J	pg/g	<PQL
			1,2,3,7,8-PeCDD	0.48 J	pg/g	<PQL, EMPC
			1,2,3,4,7,8-HxCDD	0.62 J	pg/g	<PQL
			1,2,3,6,7,8-HxCDD	1.8 J	pg/g	<PQL
			1,2,3,7,8,9-HxCDD	1.5 J	pg/g	<PQL
			1,2,3,7,8-PeCDF	5.2 J	pg/g	X, EMPC
			2,3,4,7,8-PeCDF	0.58 J	pg/g	<PQL
			1,2,3,4,7,8-HxCDF	1.2 J	pg/g	<PQL
			1,2,3,6,7,8-HxCDF	0.67 J	pg/g	<PQL
			2,3,4,6,7,8-HxCDF	0.93 J	pg/g	<PQL
			1,2,3,4,7,8,9-HpCDF	0.46 J	pg/g	<PQL, EMPC
			1,2,3,4,6,7,8,9-OCDF	9.5 J	pg/g	<PQL
			Total TCDF	30.9 J	pg/g	X, EMPC
			Total PeCDF	22.1 J	pg/g	X, EMPC
			Total HxCDF	17.1 J	pg/g	X, EMPC
2A-W-4-0-2	DY93	NWTPHD reextract	Diesel Range Hydrocarbons	12 J	mg/kg	HT
			Motor Oil Range Hydrocarbons	33 J	mg/kg	HT
2A-W-4-13	DY93	AREPH initial	C12-C16 Aromatics	120,000 J	µg/kg	MS
			C16-C21 Aromatics	500,000 J	µg/kg	MS
			C21-C34 Aromatics	1,000,000 J	µg/kg	MS
		SW8270-SIM initial	Anthracene	160 J	µg/kg	LSM
			Benzo(b)fluoranthene	< 110 UJ	µg/kg	MI
			Benzo(k)fluoranthene	< 110 UJ	µg/kg	MI
			Phenanthrene	180 J	µg/kg	FD
2A-W-4-130	DY93	ALEPH reextract	C10-C12 Aliphatics	140 J	mg/kg	HT
			C12-C16 Aliphatics	500 J	mg/kg	HT
			C16-C21 Aliphatics	590 J	mg/kg	HT
			C21-C34 Aliphatics	1,400 J	mg/kg	HT
			C8-C10 Aliphatics	39 J	mg/kg	HT
		SW8270-SIM initial	Anthracene	97 J	µg/kg	LSM
			Benzo(b)fluoranthene	< 110 UJ	µg/kg	MI
			Benzo(k)fluoranthene	< 110 UJ	µg/kg	MI
			Phenanthrene	100 J	µg/kg	FD
1C-SS-3-0-6	EA55	SW7060A initial	Arsenic	11.7 J	mg/kg	MS
1C-SS-9-0-6	EA55	SW7060A initial	Arsenic	16.9 J	mg/kg	MS
2A-GS-64-0-2	EA55	SW7060A initial	Arsenic	11.3 J	mg/kg	MS
2A-GS-66-0-2	EA55	SW7060A initial	Arsenic	5.7 J	mg/kg	MS
2A-GS-67-0-2	EA55	SW7060A initial	Arsenic	6.7 J	mg/kg	MS
2A-GS-68-0-2	EA55	SW7060A initial	Arsenic	4.5 J	mg/kg	MS
2B-SS-6-0-6	EA55	SW7060A initial	Arsenic	10.9 J	mg/kg	MS
4A-GS-13-0-2	EA55	SW7060A initial	Arsenic	13.6 J	mg/kg	MS
4-GS-10-0-2	EA55	SW7060A initial	Arsenic	41 J	mg/kg	MS
4-GS-12-0-2	EA55	SW7060A initial	Arsenic	180 J	mg/kg	MS
4-GS-15-0-2	EA55	SW7060A initial	Arsenic	35 J	mg/kg	MS
4-GS-17-0-2	EA55	SW7060A initial	Arsenic	5.1 J	mg/kg	MS
4-GS-18-0-2	EA55	SW7060A initial	Arsenic	42 J	mg/kg	MS
4-GS-26-0-2	EA55	SW7060A initial	Arsenic	14.1 J	mg/kg	MS
4-SS-5-0-6	EA55	SW7060A initial	Arsenic	12.8 J	mg/kg	MS

Table 4-1 Summary of Data Validation and Usability

Sample ID	Lab Project	Method	Parameter	Concentration		Unit	Reason Code
January 2002 Groundwater, Water, and Water Quality Control Samples							
R-3-0102	EA57	AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
MW-39-0102	EA64	AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
1A-W-3-0102	EA87	AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
1B-W-2-0102	EA87	AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
1C-W-102-0102	EA87	AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
1C-W-2-0102	EA87	AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
2A-W-10-0102	EA87	AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
2A-W-1-0102	EA87	ALEPH	C10-C12 Aliphatics	<	0.04 UJ	mg/L	SUR
			C12-C16 Aliphatics	<	0.04 UJ	mg/L	SUR
			C16-C21 Aliphatics	<	0.04 UJ	mg/L	SUR
			C21-C34 Aliphatics	<	0.04 UJ	mg/L	SUR
			C8-C10 Aliphatics	<	0.04 UJ	mg/L	SUR
		AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
2A-W-110-0102	EA87	AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
2A-W-11-0102	EA87	AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
2A-W-3-0102	EA87	ALEPH	C10-C12 Aliphatics	<	0.04 UJ	mg/L	SUR
			C12-C16 Aliphatics	<	0.04 UJ	mg/L	SUR
			C16-C21 Aliphatics	<	0.04 UJ	mg/L	SUR
			C21-C34 Aliphatics	<	0.04 UJ	mg/L	SUR
			C8-C10 Aliphatics	<	0.04 UJ	mg/L	SUR
		AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
2A-W-4-0102	EA87	AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
2A-W-5-0102	EA87	ALEPH	C10-C12 Aliphatics	<	0.04 UJ	mg/L	SUR
			C12-C16 Aliphatics	<	0.04 UJ	mg/L	SUR
			C16-C21 Aliphatics	<	0.04 UJ	mg/L	SUR
			C21-C34 Aliphatics	<	0.04 UJ	mg/L	SUR
			C8-C10 Aliphatics	<	0.04 UJ	mg/L	SUR
		AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
2A-W-7-0102	EA87	ALEPH	C10-C12 Aliphatics	<	0.04 UJ	mg/L	SUR
			C12-C16 Aliphatics	<	0.04 UJ	mg/L	SUR
			C16-C21 Aliphatics	<	0.04 UJ	mg/L	SUR
			C21-C34 Aliphatics	<	0.04 UJ	mg/L	SUR
			C8-C10 Aliphatics	<	0.04 UJ	mg/L	SUR
		AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS
EB-01-21-02	EA87	ALEPH	C10-C12 Aliphatics	<	0.04 UJ	mg/L	SUR
			C12-C16 Aliphatics	<	0.04 UJ	mg/L	SUR
			C16-C21 Aliphatics	<	0.04 UJ	mg/L	SUR
			C21-C34 Aliphatics	<	0.04 UJ	mg/L	SUR
			C8-C10 Aliphatics	<	0.04 UJ	mg/L	SUR
		AREPH	C10-C12 Aromatics	<	40 UJ	µg/L	LCS

Qualifier Definitions:

J - Estimated concentration.

UJ - Undetected, reporting limit is estimated.

Reason Codes:

ELR - Detected result is above the instrument calibration range.

EMPC - Estimated maximum possible concentration.

FD - Field duplicate percent difference exceeds quality control guidelines.

HT - Holding time exceeded.

LCS - Laboratory control spike recovery outlier.

LSM - Low spectral match.

MI - Undetected result at elevated reporting limit due to matrix interference.

MS - Matrix spike recovery outlier.

<PQL - Reported value is between the practical quantitation limit and the method detection limit.

RPD - Laboratory duplicate precision exceeds quality control guidelines.

SUR - Surrogate recovery outlier.

X - Diphenyl ether interference of this polychlorodibenzofuran peak.

Table 4-2 Analyte List and Reporting Limits

Media	Analytes	Analytical Method	Sample Container	Hold Time	Preservative	Reporting Limit Soil (mg/kg) Water (µg/L)
Soil	TPH (Diesel Extended)	NWTPH-Dx	8-oz wide-mouth glass	14 days	4 °C	10–25
	TPH Fractions	WA MTCA EPH/VPH	8-oz wide-mouth glass	14 days	4 °C	5
	PAHs	EPA Method 8270	8-oz wide-mouth glass	14 days	4 °C	33
	BTEX	EPA Method 8020	4-oz wide-mouth glass	14 days	4 °C	0.1–10
	Lead	EPA Method 6010/7000	4-oz wide-mouth glass	6 months	4 °C	2
	Arsenic	EPA Method 6010/7000	4-oz wide-mouth glass	6 months	4 °C	0.1
	TOC	EPA Method 9060	4-oz wide-mouth glass	28 days	4 °C	300
	Polychlorinated Biphenyls (PCBs)	EPA Method 8082	2-oz wide-mouth glass/teflon-lined septum (zero head space)	14 days	4 °C	25–50
Water	TPH (Diesel Extended)	NWTPH-Dx	1 liter amber glass	7 days	4 °C	200
	BTEX	EPA Method 8020	40-ml VOA vials with Teflon-lined septum	14 days	4 °C, HCl pH <2	5
	PAHs	EPA Method 8270	1 liter amber glass with Teflon-lined septum	5 days	4 °C	10